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TABLE 8.1 UPPER EXTREMITY ORTHOSIS

UPPER EXTREMITY ORTHOSIS	COMMON NAME	FUNCTION (REF.)	SPECIAL CONSIDERATIONS (REF.)
STATIC			
Finger/thumb	Neoprene thumb abductor	Places thumb in abduction to promote functional use of the hand.	Will not overcome severe cortical thumb position.
Hand	Short opponens	Places thumb in a functional position between palmar and radial abduction. Wrist and fingers are freely mobile.	Allows for full wrist flexion and extension. Should be worn at all times, removing only for hygiene and exercise.
Wrist–hand	Thumb spica	Immobilizes and protects the thumb, positioning it in opposition. In this type of splint, unlike the short opponens, the wrist is immobilized. Provides a stable post against which the index finger can pinch.	Need to allow for full MCP flexion of the fingers, especially the index finger, and full IP flexion of the thumb.
	Resting hand	Preserves a balance between extrinsic and intrinsic musculature and provides joint support when the hand is put at rest. Prevents deformity.	Should preserve the MCP joint descent and longitudinal arch following the contour of the distal palmar crease. Pressure at the MCP joint or proximal phalanx should be avoided, as this could cause injury to the MCP joint.
	Wrist cock-up	Supports, immobilizes, or stabilizes the wrist in extension. Increases mechanical advantage for grasp.	Must maintain full MCP flexion and CMC motion of the thumb. Monitor the area over the styloid process for pressure changes if a dorsal splint is used.
	Antispasticity ball	Positions the wrist, abducts the fingers and thumb, and maintains the palmar arch in a reflex-inhibiting position.	Should not be used for minimal spasticity (6).
Elbow	Elbow extension	Increases extensor range of motion and prevents flexion.	Not recommended for severe flexor contracture or fluctuating tone in either flexor or extensor patterns.
Elbow–wrist–hand	Full elbow/hand	Promotes supination at the forearm and provides a long stretch of the limb near end range to decrease tone.	Not recommended for flexor tightness.
Shoulder	Humeral orthosis	Used for humeral fractures. Stabilizes the shaft of the humerus circumferentially.	May shift position if not appropriately anchored by straps.
	Gunslinger	Used for rotator cuff repairs; positions the shoulder girdle in to slight abduction and prevents excessive tension on the repair.	Make sure the edges around the base of the splint do not cut into the hip area. Check the fitting both in standing and supine positions to accommodate the shift of the splint.
Clavicle	Harness strap	Used for displaced clavicular fractures; proximally stabilizes shoulder girdle movement and limits shoulder flexion and abduction movement beyond 90 degrees.	Must mark settings for appropriate fit due to increased adjustability. Keep a check on skin integrity around the underarm area.

(continued)

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TABLE 8.1 UPPER EXTREMITY ORTHOSIS (*CONTINUED*)

UPPER EXTREMITY ORTHOSIS	COMMON NAME	FUNCTION (REF.)	SPECIAL CONSIDERATIONS (REF.)
DYNAMIC			
Hand	MCP flexion assist splint	Gradually lengthens or gently stretches soft tissue structures that limit joint flexion; generally not used for fixed contractures.	Ensure that the traction applied is gentle to guard against soft tissue hemorrhages; microtrauma around the joints, which can cause edema, pain, and increased scarring.
	MCP extension assist splint	Passively pulls the proximal phalanx into extension while allowing active flexion; generally used for radial nerve palsy or the hemiplegic hand.	Do not position the proximal phalanx in either radial or ulnar deviation when using dynamic traction. Avoid hyper-extension of the MP joint, which can cause microtrauma and hyperlaxity to the MP volar plates.
	Finger spring—PIP extension assist	Gives dynamic traction of the PIP joint without limiting motion at the MCP joint. Assists in reducing tightness or contractures of the PIP joint.	Not recommended for severe spasticity.
Elbow	Dynasplint	Brace adjusts to lock out undesired flexion and extension. Settings are adjusted in increments of 10 degrees.	Not recommended for severe spasticity or fixed contractures.
Power	Smart-WHO	Flexor-hinge hand orthosis that immobilizes the thumb in opposition and semiflexes the IP joints of the index and middle fingers to allow the index and middle fingers to move simultaneously toward the thumb. Variations include using an external power battery pack, SMA actuators, ratchet hand position, and shoulder-driven cables (7).	Although design is lightweight and simple, a disadvantage can be the actuator's bulkiness as well as the unsightliness of the orthosis.

Abbreviations: CMC, carpometacarpal; IP, interphalangeal; MCP (or MP), metacarpophalangeal; PIP, proximal interphalangeal; SMA, spinal muscular atrophy; WHO, wrist–hand orthosis.

TABLE 8.2 LOWER LIMB ORTHOSES

ORTHOSIS	COMMON NAME	FUNCTION (REF.)	LIMITATIONS
Solid ankle foot orthosis	AFO, MAFO	Reduces tone, prevents joint contracture, and provides knee and ankle stability. Most appropriate for a child with severe tone, ankle joint hypermobility, and rigid deformities.	Does not allow any ankle movement and therefore limits smooth progression from heel strike to push off.
Hinged or articulated ankle foot orthosis	HAFO	A hinged AFO with a plantarflexion stop and free motion into dorsiflexion allows the tibia to translate over the foot in stance. This orthosis allows the foot to dorsiflex for balance reactions and improves ambulation on uneven surfaces and stairs. Posteriorly, a dorsiflexion stop strap can be added to limit the amount of dorsiflexion. A plantarflexion stop in 2–5 degrees of dorsiflexion may assist to control genu recurvatum at the knee.	Does not control "crouched" posture allowing increased dorsiflexion and knee flexion. Children with strong extensor posturing may break the ankle joint. May allow hindfoot to slip, causing mid-foot break if insufficient hindfoot dorsiflexion is present.

(*continued*)

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TABLE 8.2 LOWER LIMB ORTHOSES (*CONTINUED*)

ORTHOSIS	COMMON NAME	FUNCTION (REF.)	LIMITATIONS
Anterior floor-reaction or ground reaction ankle foot orthosis	GRAFO	Limits a "crouch" posture (stance posture with hip flexion, knee flexion, and ankle dorsiflexion). At heel strike, it encourages a force up through the anterior cuff of this orthosis, giving the knee an extension torque. Knee extension is maintained throughout stance.	A child with significant hamstring or hindfoot tightness or tone will not benefit from this orthosis.
Rear-entry hinged floor-reaction AFO		Dorsiflexion stop limits a "crouch" posture while allowing for plantarflexion during the loading phase of stance and at pushoff.	Active dorsiflexion is required to restrict foot drag during swing.
Posterior leaf spring	PLS	The trimlines of this solid AFO are posterior to the malleoli. The slender posterior portion of this AFO gives it flexibility to allow for some dorsiflexion in stance and plantarflexion at pushoff.	Does not allow full motion into dorsiflexion or plantarflexion. For medial–lateral ankle stability and arch control, another orthosis may be more appropriate. Does not control foot deformity or extensor tone. Excessive torque on spring may cause skin problems.
Dynamic ankle foot orthosis	DAFO	A supramalleolar orthosis that uses a footboard to support the arches of the foot. Provides medial–lateral ankle stability with control for pronation/supination. Allows some ankle dorsiflexion/plantarflexion.	Difficult to fit into shoes. Difficult for self-donning. Child may quickly outgrow this splint, since it is finely contoured to the foot.
Knee hyperextension splint		Maintains neutral knee and limits knee hyperextension. Uses three points of pressure: superior–anterior surface of the knee, inferior–anterior surface of the knee, and posterior to the knee joint (8,9).	Controls only the knee. Does not control extensor posturing well. It is bulky under clothes and difficult to sit with.
Swedish knee cage	KO	Controls genu recurvatum with the same three points of pressure as a knee hyperextension splint and works the same. Uses metal uprights and straps instead of plastic material (10).	Controls only the knee. It is difficult to fit to smaller children, and it is difficult to maintain correct positioning.
Knee ankle foot orthosis	KAFO	Molded plastic upper and lower leg components, usually with a locked or unlocked hinged knee joint. Four most common knee locks are free, drop lock, bail lock, and dial lock. Free knee allows full motion at the knee axis. Knee axis may be straight or offset. Offset axis has an increased extensor moment at the knee joint. The drop lock is a metal collar that slides into place to maintain the knee in extension. The bail lock is a spring-loaded lock that has a trip mechanism to unlock the knee. The dial lock is a lock that may be set in varying degrees of flexion, used to accommodate or decrease a knee flexion contracture (11).	It is bulky and difficult to don/doff. Free knee at times allows too much motion. Drop lock requires fine motor control to lock and unlock. The child must be able to get the knee fully extended to engage the drop lock. Bail locks at times become easily disengaged. Dial locks do not allow free movement through the available range.
Hip knee ankle foot orthosis	HKAFO	Hip belt and joint. Hip and knee joints may be locked or unlocked. Able to progress child to an increasing number of free joints at a time.	Bulky, difficult to don/doff. Difficult to manage clothing for toileting.

(*continued*)

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TABLE 8.2 LOWER LIMB ORTHOSES (*CONTINUED*)

ORTHOSIS	COMMON NAME	FUNCTION (REF.)	LIMITATIONS
Reciprocating gait orthosis	RGO	HKAFOs that are connected by a cable system that links hip flexion on one side with hip extension on the other. This device assists children with active hip flexion and no hip extension to advance legs with a more normalized gait. Allows the child to ambulate with a reciprocal or swing-through gait (11).	Bulky, expensive. Difficult to don/doff. Not appropriate for a child with hip and/or knee flexion contractures. Difficult to manage clothing for toileting.
Hip spica/hip abduction splint		An orthosis made of thermoplastic material and Velcro to position a newborn's legs in abduction and flexion. This splint is used to maintain the femoral head in the acetabulum to mimic normal hip formation. Use of this splint helps to avoid hip subluxation and dislocation. Used from birth up to a year.	Requires frequent repositioning. May need frequent adjustments for growth. Difficult for caregivers to maintain appropriate fit.
Pavlik harness		A soft splint used for children with the diagnosis of congenital hip dislocation. This splint is generally used in the first 9 months of age. Bilateral lower limbs are positioned with hips abducted and flexed to 90 degrees in an attempt to maintain the hips in a reduced position.	Careful positioning required. Caregivers must be vigilant in checking splint positioning.
Parapodium or Variety Village Stander		This device allows the child to stand without upper extremity support, freeing bilateral arms to do activities. Walking with this device and crutches can be quicker than with the Parapodium with a swivel device (11).	More energy expenditure than with the swivel device. Children are unable to independently don/doff or to independently transfer supine to stand and stand to supine. Device is heavy.
Parapodium with ORLAU swivel modification		This orthosis allows the child to walk without use of a gait aid and to use the arms for other activities. Less energy expenditure than with a Parapodium and crutches (6,12).	Slower than walking with Parapodium and crutches.
Twister cables		Cables are attached to a pelvic band and traverse the lower limbs to attach on shoes or AFOs. These cables provide control for increased internal rotation. Work well with children with normal to floppy tone to control internal rotation (11).	Do not work well with children with extensor spasticity. They may need to be frequently readjusted as the child grows.

Abbreviation: ORLAU, orthotic research and locomotor assessment unit.

MOBILITY AIDS

TRANSFER AIDS

There are a number of commercially available patient care lifts to assist caregivers and/or health care professionals with performing safe transfers for children. The Trans-Aid and Hoyer lift are two examples of patient care lifts. They are designed to transfer children from bed to wheelchair, off the floor, onto a toilet, into a car, or from any one room to another. Slings are available with heavy-duty support options to further minimize the effort of the caregiver while maximizing safety during the transfer. There are also institutional lifters available, which offer a 400-pound and 600-pound weight capacity, as well as portable home-care lifts, which are lightweight, portable, and designed for home doorways and narrow halls.

Powered overhead transfer lift systems provide families with a unique transfer method. This system enables users to transfer from bed to wheelchair, toilet, or bath using a motorized lift and either manual or motorized lateral movement along a permanent ceiling-mounted track or a free-standing semipermanent rack. However, this transfer system is expensive and usually not covered by insurance.

TABLE 8.3 TRUNK ORTHOSES

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TRUNK ORTHOSIS	COMMON NAME	FUNCTION	SPECIAL CONSIDERATIONS
STATIC			
Trunk	Thoracic–lumbosacral orthoses	This device is used to stabilize the spine after surgery, fractured vertebrae, or used therapeutically to provide the trunk with upright support during static or dynamic activities.	Can affect respiratory function. Brace will not correct spinal deformity, but may alter the progression of the curve.
	Theratogs/Benik	This orthotic undergarment and strapping system gives users with sensorimotor impairment tactile positioning cues for improving postural alignment, postural and joint stability and movement, skill and precision.	Can cause pressure along axillary line, breast bone, or ASIS area. Monitor wear time secondary to heat intolerance.

Abbreviation: ASIS, anterior superior iliac spine.

In addition to patient lifts, there are other smaller devices that can assist children with ease of transfers. One option is a transfer board, while another is an overhead trapeze bar attached to an over-bed frame. The most commonly used transfer board is constructed of maple wood measuring approximately 8 inches wide by 24 inches long. It is ideal for all types of transfers (bed, car, bath bench, commode, etc.). Trapeze bars may be attached overhead to bed frames to assist the child with bed mobility skills and positioning changes. The position is individually set and can be altered as needed. Typically, trapeze bars assist with supine to sitting transfers and initiating rolling side to side. They are often appropriate for use initially, but are soon removed after the child's strength and bed mobility skills improve.

STANDERS

Numerous passive standing devices are available. These devices offer many potential benefits for the child, including the provision of a sustained muscular stretch, maintenance of trunk and lower limb passive range of motion, facilitation of cocontraction of muscles, decreasing tone, and improvement in trunk and head control. Standers should be used a couple of times a day for up to a total of 1 hour. The child should progressively work to increase tolerance in the standing position. However, passive standing should not take the place of the child exploring his or her environment and body.

Three types of standers will be discussed here: supine, prone, and upright. Supine standers go from a horizontal position to approximately 90 degrees upright, depending on the model chosen. Laterals, kneepads, adduction/abduction supports, and head supports all assist to maintain the child's posture while in this stander. Bilateral upper extremity strengthening can be performed in this position, with or without a tray. However, it does not provide for any upper extremity weight-bearing. A further limitation is that it will not work to improve head and trunk control. This stander is recommended for a child with significant extensor tone and posturing and/or a child with poor or absent head control. It is also preferred over the prone stander for the larger child due to the increased ease in positioning.

Prone standers support the child anteriorly. Postural support is supplied through trunk laterals, hip guides, abductor blocks, knee blocks, and shoe holders. These standing devices do come with a chin support to aid children who have limited head control or fatigue easily. However, the child should not be permitted to "hang" on this support; a supine stander is more appropriate if the child lacks fair head control. The stander can be used to improve antigravity head control and promote bilateral upper extremity weight-bearing. Its tray may serve as a functional surface for stimulation. This stander may not be appropriate for some children with increased extensor tone. In these cases, gravity increases the work required for neck and trunk extension as well as shoulder retraction, thus feeding into primitive posturing.

Upright standers, such as the Evolv by EasyStand (Figure 8.1) maintain the child in an erect position through supports at the hips, knees, and trunk. Certain standers are available with a hydraulic or manual lift, making positioning of the larger child easier. This stander mimics a normal standing position and permits the child to work on head control and upper extremity strengthening. The seat swings to the side for ease of transfer.

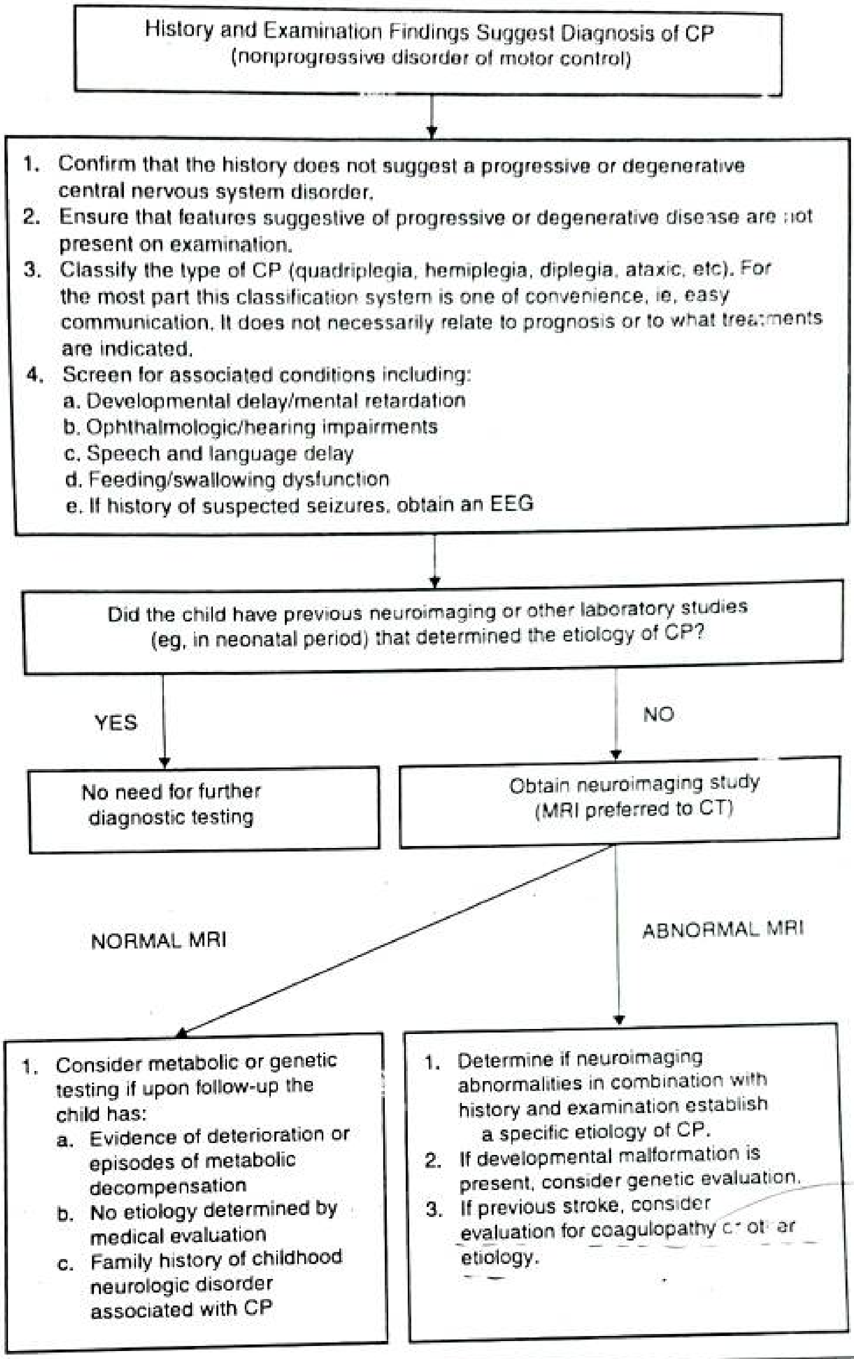

FIGURE 14.9 Algorithm for the evaluation of the child with CP.

Source: Reprinted with permission from Aswal S, et al. Practice parameter: Diagnostic assessment of the child with cerebral palsy. Report of the Quality Standards Subcommittee of the American Academy of Neurology and the Practice Committee of the Child Neurology Society. *Neurology.* 2004;62:851–863.

disorders, and metabolic disorders. Clues to a neuromuscular disorder include diminished deep tendon reflexes, weakness (which may result in absent infantile reflexes), or a positive family history. Dysmorphic features may suggest a genetic cause for hypotonia, such as Down syndrome, Prader–Willi syndrome, or Angelman syndrome. Metabolic disorders may present at any age, but are most likely to present in infancy. Metabolic disorders should be considered if a previously healthy child presents with an acute encephalopathy without an adequate explanation. Metabolic acidosis, hypoglycemia, hepatic involvement, or cardiac involvement should also prompt consideration of a metabolic disease. Dystonia and spasticity are present in a number of metabolic disorders, including mitochondrial disorders, glutaric aciduria type I, Lesch–Nyhan syndrome, and homocystinuria. A diagnosis other than CP should always be sought in children who have evidence of progressive disease or loss of previously obtained milestones.

A definitive diagnosis of CP should be made cautiously, especially in the first 6 months of life. Infants who are suspected of having CP should be followed closely

GAIT IMPAIRMENTS

A wide variety of gait classification systems have been developed to assist in diagnosis and clinical decision making, and to facilitate communication among health care providers. A systematic review of the literature, however, concluded that no single classification system appeared to reliably and validly describe the full magnitude or range of gait deviations in CP (96).

The following is a description of the more common gait deviations associated with CP (Table 14.1). At the hip, increased hip adduction tone can cause scissoring and difficulty advancing the limb in swing phase. Increased tone in the iliopsoas can lead to increased hip flexion, resulting in an anterior pelvic tilt and a crouched gait. Increased femoral anteversion can contribute to in-toeing. At the knee, tight hamstrings can inhibit the knee from extending during stance phase, further contributing to a crouched gait. Spasticity of the rectus femoris may limit knee flexion during the swing phase, causing a stiff-knee gait pattern. At the ankle, spasticity of the plantarflexors can lead to toe walking, difficulty clearing the foot during swing phase, or genu recurvatum (due to limited dorsiflexion in stance phase creating an extension moment at the knee). Spasticity of the ankle invertors, most commonly seen in spastic hemiparesis, can lead to supination of the foot and weight-bearing on the lateral border of the foot. Weight-bearing on the talar head is more common in spastic diparesis or quadriparesis, and is associated with an equinovalgus deformity. Malrotation of the leg can interfere with stability during stance phase and effective pushoff. Internal rotation is more common with a varus deformity and external rotation with a valgus deformity.

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TREATMENT

GENERAL PRINCIPLES

The treatment of a child with CP requires a multidisciplinary approach. Once the diagnosis is made, the infant or child should be evaluated by a comprehensive rehabilitation team. The members of this team will vary, depending upon site and availability. Potential team members may include a physiatrist, developmental pediatrician, orthopedist, neurologist, physical therapist, occupational therapist, speech and language pathologist, therapeutic recreation specialist, orthotist, psychologist, social worker, and a nutritionist. The team should work with the child's caregivers to develop short- and long-term goals that address neuromuscular concerns such as maintaining ROM and tone control, as well as functional goals related to self-care skills, mobility, and communication. Goals related to increased societal participation should also be included. Goals should be routinely reassessed to ensure that they continue to be valid as the child grows older, and the child should be encouraged to take an active role in goal setting when appropriate.

Once the goals are determined, the family and the team must determine the most appropriate therapeutic approach. Although there are many treatment options to

TABLE 14.1 COMMON GAIT DEVIATIONS IN CP

LOCATION	IMPAIRMENT	POTENTIAL EFFECTS
Hip	Increased adductor tone	Scissoring; difficulty advancing leg in swing phase
	Increased iliopsoas tone	Anterior pelvic tilt; increased lumbar lordosis; crouched gait
	Increased femoral anteversion	In-toeing; false genu valgus; compensatory external tibial torsion
	Abductor weakness	Trendelenburg's gait
Knee	Decreased hamstring range of motion	Crouched gait
	Hamstring/quadriceps cocontraction	Stiff-knee gait
Ankle	Increased gastrocsoleus tone or contracture	Toe walking; genu recurvatum; difficulty clearing foot during swing
	Internal tibial torsion	In-toeing; ineffective pushoff
	External tibial torsion	Out-toeing; ineffective pushoff
	Varus	Increased ankle supination in stance or swing
	Valgus	Increased pronation in stance or swing; mid-foot break

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TABLE 14.2 MEDICATIONS USED TO TREAT SPASTICITY IN CHILDREN

DRUG	MECHANISM OF ACTION	SIDE EFFECTS AND PRECAUTIONS	PHARMACOLOGY AND DOSING
Baclofen	Binds to receptors (GABA) in the spinal cord to inhibit reflexes that lead to increased tone Also binds to receptors in the brain leading to sedation	Sedation, confusion, nausea, dizziness, muscle weakness, hypotonia, ataxia, and paresthesias Can cause loss of seizure control Withdrawal can produce seizures, rebound hypertonia, fever, and death	Rapidly absorbed after oral dosing, mean half-life of 3.5 hours Excreted mainly through the kidney Dosing: in children start with 2.5–5 mg/d, increase to 30 mg/d (in children 2–7 years of age) or 60 mg/d (in children 8 years of age and older)
Diazepam	Facilitates postsynaptic binding of a neurotransmitter (GABA) in the brainstem, reticular formation, and spinal cord to inhibit reflexes that lead to increased tone	Central nervous system depression causing sedation, decreased motor coordination, impaired attention and memory Overdoses and withdrawal both occur The sedative effect generally limits use to severely involved children	Well absorbed after oral dosing, mean half-life 20–80 hours Metabolized mainly in the liver In children, doses range from 0.12–0.8 mg/kg/d in divided doses
Clonidine	Alpha 2 agonist Acts in both the brain and spinal cord to enhance presynaptic inhibition of reflexes that lead to increased tone	Bradycardia, hypotension, dry mouth, drowsiness, dizziness, constipation, and depression These side effects are common and cause half of the patients to discontinue the medication	Well absorbed after oral dosing, mean half-life is 5–19 hours Half is metabolized in liver and half is excreted by kidney Start with 0.05 mg bid, titrate up until side effects limit tolerance May use patch
Tizanidine	Alpha 2 agonist Acts in both the brain and spinal cord to enhance presynaptic inhibition of reflexes that lead to increased tone	Dry mouth, sedation, dizziness, visual hallucinations, elevated liver enzymes, insomnia, and muscle weakness	Well absorbed after oral dosing, half-life 2.5 hours Extensive first pass metabolism in liver Start with 2 mg at bedtime and increase until side effects limit tolerance, maximum 36 mg/d
Dantrolene sodium	Works directly on the muscle to decrease muscle force produced during contraction Little effect on smooth and cardiac muscles	Most important side effect is hepatotoxicity (2%), which may be severe Liver function tests must be monitored monthly, initially, and then several times per year Other side effects are mild sedation, dizziness, diarrhea, and paresthesias	Oral dose is approximately 70% absorbed in small intestine, half-life is 15 hours Mostly metabolized in the liver Pediatric doses range from 0.5 mg/kg bid, up to a maximum of 3 mg/kg qid

Source: Reprinted from Ref. (188). Green LB, Hurvitz EA. Cerebral palsy. *Phys Med Rehabil Clin N Am.* 2007;18(4):866–867, with permission from Elsevier.

clonidine and tizanidine, as well as certain anticonvulsants, including gabapentin (Neurontin). The alpha 2 agonists result in decreased motoneuron excitability by decreasing the release of excitatory amino acids (182). The side effects associated with these agents are frequently the cause of their more limited use and include nausea, vomiting, hypotension, sedation, dry mouth, hallucinations, and hepatotoxicity. In addition, reversible liver enzyme elevations have been noted in 2% to 5% of patients (170). There is little literature to guide the effective use of tizanidine for the management of spasticity in children with CP (155). Gabapentin is structurally similar to GABA, readily crosses the blood–brain barrier, and is not protein-bound. It does not activate GABA, but results in increased brain levels of it (170). Reports of its use in children with spasticity are not available as of yet.

INTRATHECAL BACLOFEN (ITB)

ITB was first described by Penn and associates in 1984 and was FDA-approved for the treatment of spasticity of cerebral origin in 1996. Baclofen is delivered directly to the cerebrospinal fluid (CSF) via a catheter connected to an implanted device in the abdomen. The device contains

TABLE 14.3 OUTCOME MEASURES USED IN CP

	BODY STRUCTURE	BODY FUNCTION	ACTIVITY AND PARTICIPATION	QUALITY OF LIFE OR NON-ICF DOMAINS
Administered by questionnaire or self-report		Child Health Questionnaire (260) PedsQL (261)	Pediatric Outcomes Data Collection Instrument (262) PedsQL (261) Pediatric Evaluation of Disability—CAT (263) Children's Assessment of Participation and Enjoyment and Preferences for Activities for Children (264) Assessment of Life Habits for Children (265)	Cerebral Palsy Quality of Life—Child (266) PedsQL (261) Child Health Questionnaire (260)
Measured by a trained investigator or with specialized equipment	Functional MRI (267) MRI (36) Diffusion tensor imaging (268) Transcranial magnetic stimulation (269) Positron emission tomography (PET) scan (270)	Spasticity [Ashworth Scale (271), Modified Ashworth Scale (272), *Tardieu Scale* (273), specialized systems (274)] Strength [muscle *grading* or dynamometry (275)] *Hypertonia Assessment Tool* (276) Range of motion (277) Electromyography (278)	Gross Motor Function Measure (279) Gross Motor Performance Measure (280) Gait analysis [observational *scales* (281,282) *to instrumented digital analysis* (283)] Quality of Upper Extremity Skills Test (284) Assisting Hand Assessment (285) Melbourne Assessment of Unilateral Upper Limb Function (286) *Functional Independence Measure for Children (WeeFIM) (287)* Pediatric Evaluation of Disability Inventory (288) Bruininks–Oseretsky Test of Motor Proficiency (289) Energy expenditure/efficiency (290) Movement monitoring (291) Timed walking (292) Canadian Occupational Performance Measure (293)	*Goal Attainment Scaling* (294) KIDSCREEN (295)

Note: Italicized measures are commonly used in clinical settings and may also be used for research, whereas other measures are predominantly research tools.

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